



Production Management

Elixir Prod. Mgmt. 90 (2016) 37765-37775

Elixir
ISSN: 2229-712X

Assessment of R & D Capabilities with Considering of NPD' View in Iran Khodro Company

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ARTICLE INFO

Article history:

Received: 26 December 2015;

Received in revised form:

12 January 2016;

Accepted: 18 January 2016;

Keywords

Technology,
Research and Development
Capability,
New Product Development,
Assessment.

ABSTRACT

In the current paper, firstly literature is reviewed and various R & D assessment models in different industries are studied and finally, an assessment model selected that can evaluate R & D capabilities with the approach to new products development in automotive industry. Meanwhile this model has been tested in that article by structural equations and AMOS software, and also it was divided into 9 main classes with 29 indexes. In this research For the research purpose, firstly face validity, and then content validity was calculated using CVR form and Cronbach's reliability was calculated for research tool. Following approval of these items, questionnaires were distributed among 40 experts in Iran Khodro Co. working in engineering, new products development, quality and other units cooperating with R & D unit. Then, scores were given to 29 indexes by automotive industry experts and final score of 29 indexes and 9 main dimensions were evaluated. Considering obtained scores it was specified this company has highest capability in financial capability (80.83%) and technology capability (80.08%) dimensions compared to other dimensions. Also, it has lowest capability in strategic capability (61.38%) and customer and market capability (62.03%) dimensions compared to others. In addition, intellectual capital (70.17%), organizational structure (71.17%), research and design (73.17%), management (73.42%), and new products development process (77.50%) capabilities are in average level compared to other dimensions. Finally, some recommendations are made regarding dimensions and indexes with lower score in the organization.

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Introduction

Nowadays concept of development includes various meanings and aspects which especially cover economy, society, policy, and culture. Due to intertwining of economic, social, political and cultural issues in the contemporary societies and their mutual effects on each other, preference of development in one field over other one seems difficult, unnecessary and incorrect. To this end, most theorists of social and economic sciences believe that economic development is closely relevant to development in other areas (Hayami, 2001). Most companies follow systemic approach for evaluation of product development in today competitive and changing world in order to succeed in new product development. Product performance analysis after its entrance to the market does not suffice; rather it is necessary that product development process is regularly and precisely evaluated from the beginning of the development program until its market delivery and offer stage. The main issue is that what should be evaluated and measured so that meaningful results can be extracted and used in the product development and improvement process. Identifying success or failure of the products is not an easy task, because a product may be successful in one aspect and it may fail in the other one at the same time. Such contrast without having technical competence' commercial success is impossible. However,

technical competence of products also does not always guarantee commercial success. In addition, failure probability of products with long development period reduce company sale, because in one hand expectations of customers vary over the time and on the other hand, competitors may offer their new products to the market.

The more resources are spent on new product development process; new product development cost is increased, which influences product development program performance (RajabzadehGhotri, 2014). Economic success of manufacturing enterprises depends on their ability in identifying customer needs and quick production of products meeting their needs in low cost. Achieving such goals is not merely a marketing or design or production issue, rather it is a product development issue which covers all mentioned areas too (Ulrich, 2012). Essentially giving a single prescription for the whole companies is not possible, since the nature, strategy, and ideals of the companies, and more importantly, type of product and good are factors which complicate the issue. Which complicate the issue. The general pattern of new product development is from the idea to the customer devily (Chen et al., 2012). Thus, it is clear that R & D units are one of the major parts of the organizations especially manufacturing ones, which their main task is new product development. New product development requires meeting

customer needs and bringing profitability for the organizations in order to be successful. Hence, current research attempts to study Iran Khodro Co., which is one of the greatest Iranian automotive companies, as the case, and this organization is evaluated using evaluation model of R & D capabilities with the approach of new product development. Finally, effective dimensions are concluded and discussed.

Theoretical Foundations and Review of Literature

Theoretical Foundations
Overall, new product development is a collection of activities and solutions for growth which lead to partial or total change and modifications of the product in the current market within different stages of the product production (Cooper, 1990). Barclay summarizes concept of the product newness in newness of product production, technology, and performance factors (Barclay et al., 2000). Presence of such indexes as newness of product for the country, change in product distribution network, packaging improvement and modification, and production method improvement are considered for product development (Crawford, 2002).

Structure of New Product Development Teams: The teams can be structured in several ways. One of the most famous typologies classifies teams into four classes: task, light weight, heavy weight, and autonomous (Schilling, 2008).

Product Development Organizations: A product development organization is the plan by which designers and developers within the groups are connected. Relationship between these individuals may be formal or informal including reporting communications, financial agreements and physical layout (Ulrich, 2012).

Research and Development: Research includes fundamental sciences with no specific direction or applied sciences with specific direction. Development in research may be a result of innovation in products or process. Research is different from product development in the way that research is exploring an idea, rather than tangible offer of a product or service to the market (Malekzadeh, 2001).

FRASCATI Manual classifies research into following parts: 1. basic or pure research, 2. Applied research. Basic research is theoretical or experimental work essentially for the purpose of new knowledge acquisition from implicit foundation and basis of phenomena or objective facts. This type of research has no specific practical purpose or application. Applied research is serious investigation for acquisition of new technical or practical knowledge and its direction is toward a specific purpose.

Development: Using technical or practical knowable in order to create advanced things such as new products, tools or goods as well as producing new processes, that is, services or systems prior to production start or commercial application and modification of previously developed or produced things (Samoons, 2006).

According to Dumbilton, generally modeling research and development process is useful, because by which it is possible to recognize main success factors in research and development. According to him, it seems there is no single general model suitable for research and development process at every state. Thus, instead of finding a general model for research and development process, it is better to provide a simple linear model for it (Ehsani, 2006).

Dumbilton argues that research and development inputs are classified to resources and information. Resources include human resources, equipment, tools, building, etc. in other words, these are the expenditures spent on research and

development. Thus, return of assessment is expected by the managers. On the other hand, it should be considered that information is main part of inputs. Hence, research and development is information production and exchange process. Thus, considerable percentage of outputs would as plan, paper, and information related to product production and design (Sadrinia, 2008).

Characteristics of a Successful Product Development: Five specific aspects, which are all totally related to profitability, are usually applied in evaluation of the product development including product quality, product price, development period, development cost, and development capability. These five aspects finally lead to economic success, though other criteria are also important. Product development is an interdisciplinary activity which demands participation of almost all parts of the enterprise. Three parts are almost always in the center of the product development project:

Marketing, this is medium between the company and customers. It facilitates identification of customer needs. Also, marketing is usually used for regulating relationship between the company and customers, determining target costs and beyond it, establishing and promoting product.

Design is considered as physical form of the product so that its responds customer needs in the best way and it has strategic role. Design part includes engineering design and industrial design.

Production part which mainly is responsible for design and implementation of production system in order to produce the product. In wider definition, production part often includes purchase, distribution and launch. This collection of activities is also known as supply chain. In fact a few numbers of products can be developed within less than one year. Most of them require 3 to 5 years and some may even last for 10 years. Product development costs are approximately appropriate to the project team individuals and project period. In addition to product development activities cost, the company should always have investments on the tools and equipment needed for the product. Such cost is usually equal to the total budget of the product development, though sometimes such costs can be assumed production constant (Ulrich, 2012).

Product strategic development management can be investigated from two perspectives: direction strategies and tasks strategies. Thus, if such investigation is done on product development and new product development, better analysis would be obtained. In the first type, if the company is not able to produce new product and it can make some changes in the previous product or develop it and offer to the current markets, then it has used intensive growth strategy. In the second type, a new product is produced. In this state, development strategy is of variety type, because the product is changed and perhaps type of markets for the product and market demand is also changed (Ansari and Mamghani, 2011).

Product Development Process in New Way: Stages include: 1. Need identification and project approval stage, 1. Planning stage, 3. Integration stage (MD and M East, 2004).

KORT introduced three types of knowledge which are used by product developers in new product development process: general knowledge, field specific knowledge, and process knowledge (Huang et al., 2004).

New Product Development Patterns: Patterns raised in new product development can be classified into two classes: 1. Patterns which focus on traditional criteria such as efficiency and reliability, like consecutive patterns, 2. Patterns which

focus on new indexes such as agility and resilience, such as flexible, integrated and self-improvement new product development (Rajabzadeh and Moazi, 2014).

Rainey (2005) stated a six-step model for analyzing new product development process including idea making, concept development, program development, design and development, approval, commercialization, and launch. Often total stages of new product development occur within several specific stages and consecutive processes. In general state, new product development is summarized in six steps including idea development, idea screening, executive plan, product development, market test, and commercialization (Rainey, 2005).

Kumar (2005) in his book entitled *New Product Development* introduced two major classifications for new product development: product development using innovation strategy and product development using customer oriented

strategy. Product development with innovation strategy focuses on radical and gradual innovations, while customer oriented strategy emphasizes on establishing relationships with the market and customers in product development process (Kumar, 2005).

Ilori (1980) proposes that prior to introducing product to the market; the market power should be measured. All aspects including market size, current and expected market share, and profit returns should be accurately considered by the project manager. Some authors believe that market environment should be always analyzed in advance (Mansfield and Wanger, 1975).

Review of Literature

Review of literature is summarized as Table 1 and summary of indexes and factors affecting research and development capability with new product development approach is given in Table 2.

Table 1. Review of Literature

No	Research Subject	Author(s)	Research Results
1	Multi-dimensional assessment structure	(Griffin, 1997)	Three dimensions: (1) financial success,(2) customer-oriented success, (3) technical performance success
2	Critical success factors in development of new products in China	(Moo et al., 2007)	Factors such as, (1) technology, (2) marketing and, (3) management, (4) commercialization
3	Virtual research and new products research and development teams	(Ebrahim , 2008)	Three basic elements: (1) creating innovation space,(2) appropriate technology with new products, and (3) use of portfolio management
4	Developing a model for new product development in small and medium companies	(Cristina Hernandez, 2014)	Four steps:(1) planning,(2) early detection,(3) final and deeper diagnosis, (4) using SWOT technique
5	Identification and prioritization of most important organizational criteria for success of new product development in textile industry in Iran	Sadeghi, 2012	HR (52.26%) has highest role in new product development success and development resources, experimental resources and launch resources are in the next levels of importance with 25.41%, 11.16%, and 11.16%.
6	New product development (NDP) process performance evaluation based on Balanced Scorecard criteria (BSC)	(Sabzali, 2012)	Value or profit shares were considered as the first rank, customer satisfaction level with existing products was in the second rank and customer need meet was in the third rank. It was done in six phases.
7	Ranking key factors in new product development in automotive industry (case study: SAIPA Automobile Manufacturing Group (Saipa Group)	(Mamghani, 2009)	Four key factors and 20 indexes were identified for new product development process as key factors including: (1)Technology factors, (2) marketing factors, (3) commercial factors and, (4) management factors of product development team.
8	Key factors affecting the success of new product development	(Nazemi ,2012)	Four factors: (1) Technology factor, (2) Marketing factor, (3) Innovation factor, (4) Product development team factor
9	Factors affecting R & D effectiveness	(Salami ,2008)	In two groups including A. managementcharacteristics, B. other internal organizational factors on R & D effectiveness
10	Factors affecting organization of new product development team	(Modares ,2008)	Four aspects: structure, process, system, and culture
11	Identifying and prioritizing key success factors of new product development with a view to Fuzzy Inference System	(JafariKhanshir, 2012)	Three groups included: development Team's capabilities, organizational resources and systems, and organizational processes.
12	Identifying and prioritizing critical success factors in new product development in small and medium-sized businesses based in science and technology parks in Tehran	(Talebi, 2011)	classification of eight factors, including sensitivity and capacity of market, competitiveness capabilities, marketing and income, product and innovation, management and financial capabilities, expertise of inventor, technological advantages, costs and profitability.
13	Reviewing and rating factors affecting new product development process (case study: management of SMEs in food and beverage industries in Fars Province)	(Saeida Ardakani, 2011)	Five critical factors affecting new product development including technologic, critical, marketing, internalization and commercialization factors

Table 2. Summary of Indexes and Factors Affecting Research and Development Capability with Approach to New Product Development

No	Author	Indexes & Affecting Factors
1	(Fadaeemanesh and Kumar ,2011)	Assessment of methods for value delivery to customers by R & D unit, presence of statistician experts, marketing, finance and resources, HR culture making, ability to produce and release new product and process, ability to increase the technology level, ability to increase knowledge about the human, having following elements: creativity, innovation and use of scientific methods and creation of new knowledge, use of material, intellectual and identification incentives for employees
2	(Schilling, 2008)	Having ability to use knowledge for production of useful materials and processes, creating positive technological overflow from research and development unit, an appropriate structuring in teams for new product development.
3	(Samoons, 2006)	Basic and applied research and development in research and development organizations
4	(RajabzadehGhotri, 2014)	More efficient use of resources new product development process
5	(Huang et al., 2004)	Use of general knowledge, specific knowledge and knowledge of processes in new product development process.
6	(Jacobs, 2001)	Using various techniques, such as techniques of quality function, as soon as identification of customer requirements, to include their demands in product design
7	(Rajabzadeh and Moazi, 2014)	Using new product development process as five stages: concept development, detailed design, testing and refinement, sending product to market, using new product development models
8	(Barczak et al., 2009)	Using various details such as: strategy, research, commercialization, process, project space, corporate culture and performance.
9	(Rainey, 2005)	Using six-step model: ideas, development of concept, design and development, validation, commercialization and launch
10	(Kumar, 2005)	Using main categories for new product development: development of products with innovation strategy, and development of new products with customer-oriented strategy.
11	(Mansfield and Wanger, 1975)	Measuring market power before market introduction in all aspects: market size, current and expected market share and expected profits.
12	(Jansoon, 2004)	Interaction of seven public processes during project and construction of process and performance indicators including processes of: (1) decision-making and management, (2) construction of prototypes, (3) production, acquisition and utilization of knowledge, (4)idea formation, (5) team formation, (6) implementation process, (7) integration.

Research Question

What is level of research and development capabilities with approach to new product development in Iran Khodro Co.?

Research Method

Approach of the research is descriptive and of quantitative and survey type. It is also a case study. It is considered as applied research in terms of results and it is a field study in terms of method.

Local and Temporal Scope and Research Subject

Temporal Scope: Research period is during February 20, 2015 - August 22, 2015.

Local Scope: Location of the research is in Iran, Tehran, Iran Khodro Co. located in km 14, Karaj Specific Highway.

Subject Scope: Subject of the research is included in technology management, research and development, and new product development area.

Statistical Population

Statistical population includes experts in Iran Khodro Co. with at least five years of experience in working in research and development, new product development, engineering, production, quality and other technical units related to new product development. Their minimum educational degree is bachelor.

Sample Size and Sampling Method

Research statistical population included automotive industry experts. Total counting was used for acquiring more accurate information. Questionnaires were distributed among 40 experts in Iran Khodro Co. working in engineering, new product development, quality and other units cooperating with R & D unit.

Evaluation Model

The model shown in Fig 1 was used for evaluation of research and development capabilities with approach to new product development in automotive industry. In addition, its indexes are explained in detail in Table 3.

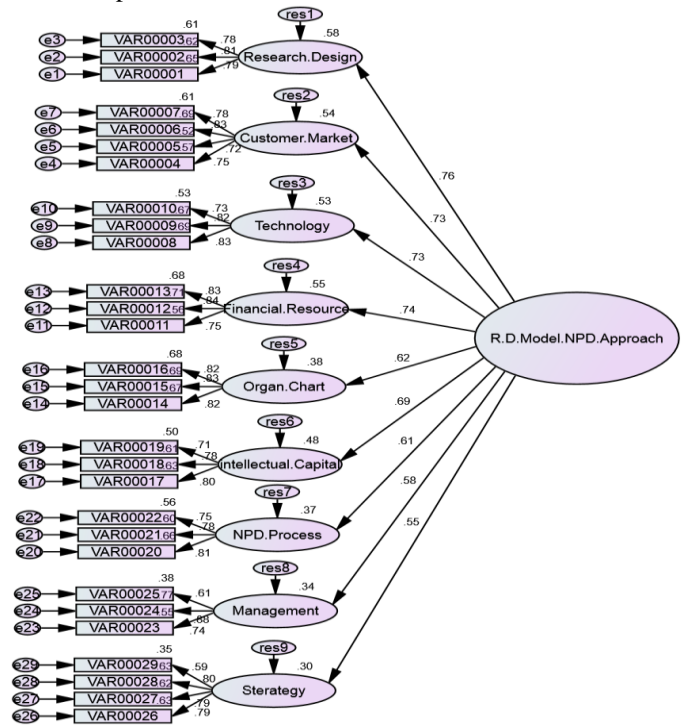


Figure 1. Evaluation model of research and development capabilities with approach to new product development in automotive industry (Azar and Hanifi, 2015)

Table 3. Components and Indicators of model of research and development capabilities with approach to new product development in automotive industry (Azar and Hanifi, 2015)

No.	Aspect	Affecting Factors or Indexes
1	Research & design capability	R & D organization should be able to perform basic and applied research works for designing a new product
2		R & D organization should constantly create innovation on new ideas of new product design and production, since the beginning until its maturity
3		R & D organization should use CAD and CAM for design and production of prototype of new products
4	Customer & market	R & D organization firstly receives ideas of customers, competitors and other sources, and screen them and uses their best and most suitable ones, and it should consider financial and non-financial incentives for the idea making customers
5		Following provision of new products to the customers, performance and quality analysis should be done by R & D organization
6		R & D organization should measure power, size and share of market and profit prediction prior to introduction of new product to the market
7		New products should be suitable in terms of price and quality in the view of customers
8	Technology capability	R & D organization should have the ability to perform technical changes and improvement to imported technologies from other places for turning imitation to innovation
9		R & D organization should be able to increase knowledge and technology science level and step toward management of these areas specially technology management
10		It should have technical and knowledge ability to transfer older technologies to other organizations or countries
11	Financial resources capability	R & D organization should be able to have investment with no short-term returns
12		R & D organization should be able to send personnel to research trips, seminars, conferences, scientific courses, etc.
13		R & D organization should afford to import suitable and necessary technologies for new product development.
14	Organizational structure	Research unit should be separate from development unit
15		R & D organization should use matrix and suitable structure for new product development in order to have better performance
16		New product development and design should be done in cooperation with research and development, engineering, equipment, production, marketing units as well as related units with sectional activities of project, and resources and facilities should be used in the form of multipurpose teams in new product development
17	Intellectual capital capability	In R & D organization, there should be different experts including experts in statistics, marketing, finance and HR for analyzing current status and optimal status
18		R & D organization should use human capital of its staffs (implicit and explicit knowledge) properly for developing new products
19		R & D organization should use organization's structural capital (implicit knowledge related to internal processes of organization including software, hardware capitals, databases, etc.) to support the productivity
20	New product development process	New product development process should be flexible so that change in the method, product, strategy or probable improvement is possible.
21		Problems remaining from initial design and production phases including performance and appearance problems in the product, labor force training for mass production, technical and equipment deficiencies, and other cases related to mass production should be investigated during new product development process in different phases, and defects should be overcome.
22		R & D organization should perform new product development activities according to suitable process (processes such as customer need identification, product characteristics determination, objective characteristics, concept production, concept testing, final characteristics of product, project planning, economic analysis, modeling competitive products, modeling and sampling)
23	Management capability	R & D organization management should use constantly stimulus with positive responses from employees in order to stay in optimal motivation level for them, for example, it can use material incentives (money, cash reward, etc.) and spiritual incentives (job promotion, etc.), conceptual incentives (verbal encouragement, praise and thanks)
24		R & D organization should have expert, experienced and informed manager aware of most affairs related to new product development project such as cost management, financial management, quality management, risk management, HR management, project management, etc. in defined intervals and evaluate sale percentage performance and production number, profit percentage, etc.
25		R & D organization management should be as a model (in terms of reliability, truth, etc.)
26	Strategy capability	R & D organization should firstly specify total and partial goals for new product development programs prior to sale and profit taking.
27		R & D organization should adopt different and appropriate strategies such as new product platform, derivatives of product platform, etc. during organization's products lifetime and consider innovation and customer-
28		There should be appropriateness between organization's business and ability of R & D organization and role of new products in achieving organization's business goals should be clearly specified for all
29		Development of new products should be planned with the purpose of internal markets in addition to domestic markets.

Data Collection Method and Research Tools

In the current research, questionnaire was used as data collection tool. 29 items were specified, and type of items was close form, and range of answers was 0 to 10.

Data Analysis Methods

SPSS software as well as database software was used for data analysis.

Research Tool Validity

In order to investigate face validity, questionnaires were distributed and completed by 10 experts of automotive industry and academicians, and it was approved structurally and conceptually by the experts.

Following approval of face validity, CVR form was prepared in order to investigate content validity, and it was distributed among 10 experts of automotive industry and academicians. It should be noted that CVR was calculated using formula (1). It was obtained above 0 for 29 items and thus it was approved. Hence, it can be stated the questionnaire has content validity. Meanwhile all the CVR scores of indicators are shown in table 4.

$$CVR = \frac{N_E - \frac{N}{2}}{\frac{N}{2}} \quad (1)$$

Table 4. CVR Scores for 29 Items of Questionnaire

Item No.	CVR Score	Status	Item No.	CVR Score	Status
1	1	Confirmed	16	0.66	Confirmed
2	1	Confirmed	17	0.33	Confirmed
3	1	Confirmed	18	1	Confirmed
4	1	Confirmed	19	1	Confirmed
5	0.86	Confirmed	20	0.33	Confirmed
6	0.73	Confirmed	21	0.66	Confirmed
7	1	Confirmed	22	0.33	Confirmed
8	1	Confirmed	23	1	Confirmed
9	0.86	Confirmed	24	0.8	Confirmed
10	0.53	Confirmed	25	0.86	Confirmed
11	0.73	Confirmed	26	0.73	Confirmed
12	0.86	Confirmed	27	0.86	Confirmed
13	0.46	Confirmed	28	0.66	Confirmed
14	0.33	Confirmed	29	1	Confirmed
15	1	Confirmed			

Regarding reliability of research tool

Reliability of questionnaire with 29 final items was examined in the expert population of automotive industry using SPSS software, and Cronbach's alpha reliability in 9 components of the model was above 0.7. Thus, research tool enjoys acceptable reliability.

Table 5. Latent Variables Reliability

Latent Variable	Reliability	Index Number
Research and design capability	0.83	3
Customer and market capability	0.85	4
Technology capability	0.83	3
Financial capability	0.84	3
Organizational Chart	0.82	3
Intellectual capital capability	0.86	3
New product development process capability	0.80	3
Management capability	0.78	3
Strategy capability	0.83	4
Total Cronbach's alpha reliability (research and development capability with a view to new product development)	0.92	29

Cronbach's alpha reliability table for latent variables is given in Table 5.

Findings

Descriptive Statistics of Research Population

Age, education and working experience of respondents to the questionnaire in Iran Khodro Co. are given in Figures 2, 3, and 4, and also central tendency and dispersion indexes in descriptive statics are given in table 6.

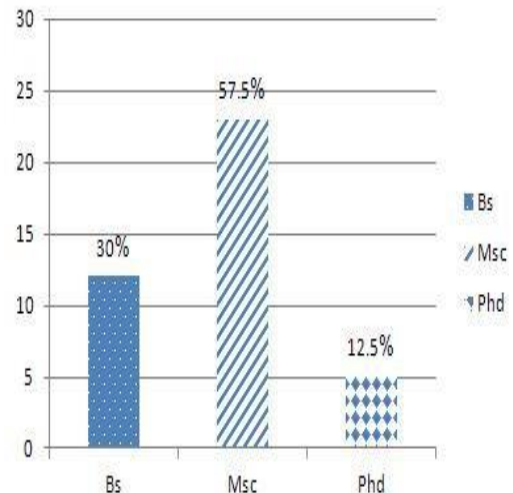


Figure 2. Education frequency in statistical population

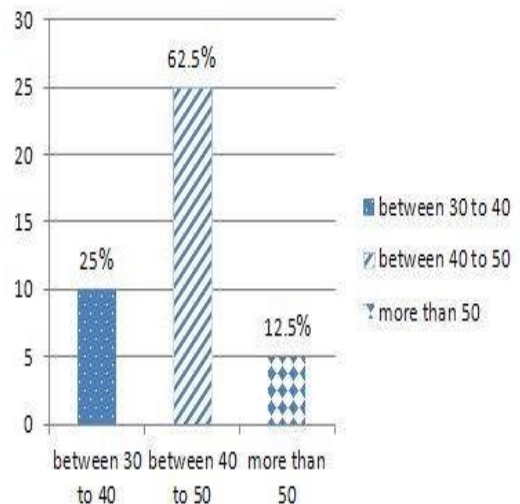


Figure 3. Age frequency in statistical population

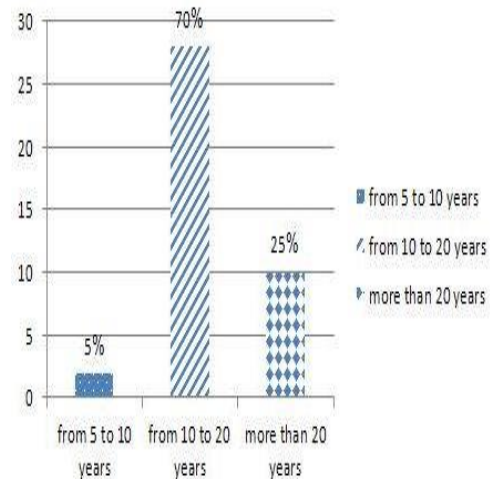


Figure 4. Working experience frequency in statistical population

Descriptive Statistics of Research Population

Table 6. Central Tendency and Dispersion Indexes in Descriptive Statistics

Index	Central Tendency Indexes			Dispersion Indexes		
	Mean	Mode	Median	SD	Variance	Range of Changes
1	6.92	7	7	0.69	0.48	2
2	6.67	7	7	0.99	0.99	4
3	8.35	8	8	0.80	0.64	3
4	5.02	5	5	0.86	0.74	4
5	5.60	5	5	1.10	1.22	4
6	6.87	7	7	0.68	0.47	2
7	7.32	7	7	0.76	0.58	3
8	8.12	8	8	0.82	0.67	3
9	7.22	7	7	0.76	0.58	3
10	8.67	9	9	0.61	0.37	3
11	7.85	8	8	0.76	0.59	2
12	8.02	8	8	0.65	0.43	2
13	8.37	8	8	0.54	0.29	2
14	6.75	7	7	1.12	1.26	4
15	7.00	7	7	0.90	0.82	3
16	7.30	7	7	0.64	0.42	3
17	7.32	7	7	0.47	0.22	1
18	8.52	9	9	0.55	0.30	2
19	7.40	7	7	0.54	0.29	2
20	6.72	7	7	0.78	0.61	2
21	7.02	7	7	0.89	0.79	3
22	7.60	8	8	1.05	1.11	3
23	7.22	7	7	0.61	0.38	2
24	7.75	8	8	1.00	1.01	3
25	7.05	7	7	0.74	0.56	3
26	6.20	6	6	0.75	0.57	3
27	5.92	6	6	0.52	0.27	2
28	6.57	7	7	0.59	0.35	2
29	5.85	6	6	0.62	0.38	2

Research Question Answer

Q: What is level of research and development capabilities with approach to new product development in Iran Khodro Co.?

A: Considering that one of research questions is measurement of R & D capabilities in Iran Khodro Co., to this end, final indexes with 29 items confirmed in this research were distributed among 40 experts of Iran Khodro Co. so that their technical ideas are obtained. Finally, the results were gained, and are shown in table 7.

Table 7. Level of Research and Development Capabilities with Approach to New Product Development in Iran Khodro Co

Main Dimension	Obtained Score of Main Dimension (R&D Capability with NPD Approach)	Minor Dimensions	Obtained Score of Minor Dimension	Factor or Indexes	Obtained Score of Factor or Indexes		
R&D capability with NPD approach in Iran Khodro Co.	72.08%	Research and design Capability	73.17%	Factor 1	69.30%		
				Factor 2	66.80%		
				Factor 3	83.50%		
		Customer and market	62.03%			Factor 4	50.03%
						Factor 5	56%
						Factor 6	68.80%
						Factor 7	73.25%
		Technology Capability	80.08%			Factor 8	81.30%
						Factor 9	72.25%
						Factor 10	86.80%
		Financial resources Capability	80.83%			Factor 11	78.50%
						Factor 12	80.30%
						Factor 13	83.80%
		Organizational Structure	71.17%			Factor 14	67.30%
						Factor 15	70.03%
						Factor 16	76%
		Intellectual capital Capability	70.17%			Factor 17	67.50%
						Factor 18	70%
						Factor 19	73%
		New product development process Capability	77.50%			Factor 20	73.30%
						Factor 21	85.30%
						Factor 22	74%
		Management Capability	73.42%			Factor 23	72.30%
						Factor 24	77.50%
						Factor 25	80%
		Strategy Capability	61.38%			Factor 26	62%
						Factor 27	59.30%
						Factor 28	65.80%
						Factor 29	58.50%

Conclusion, Discussion and Comparison to Reviewed Literature

Results of Current Research

Considering evaluation of research and development unit in Iran Khodro Co. with an approach to new product development using the research model it was found that the company has highest capability in financial capability (80.03%) and technology capability (80.08%) dimensions compared to other dimensions. Also, it has lowest capability in strategic capability (61.38%) and customer and market capability (62.03%) dimensions compared to others. In addition, intellectual capital (70.17%), organizational structure (71.17%), research and design (73.17%), management (73.42%), and new product development process (77.50%) capabilities are in average level compared to other dimensions. In addition, acquired capabilities are separately shown in Figures 5 – 14.



Figure 5. R and D capability status with an approach to new product development in Iran Khodro Co

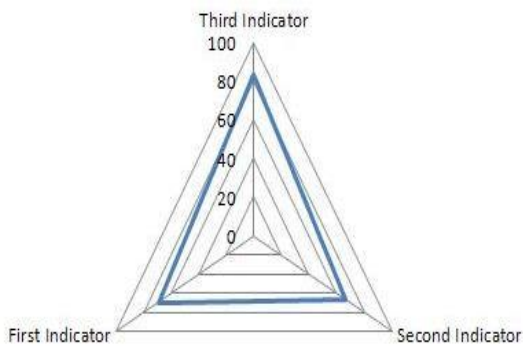


Figure 6. Research and design capability

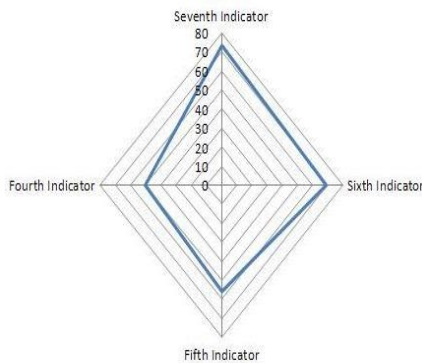


Figure 7. Customer and market capability

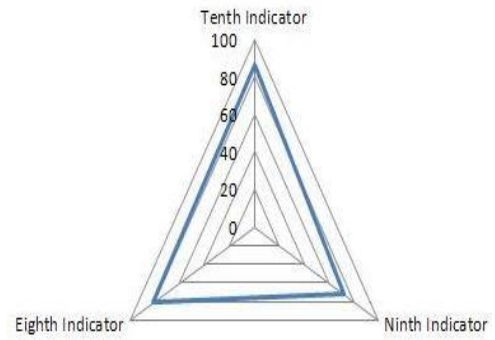


Figure 8. Technology capability

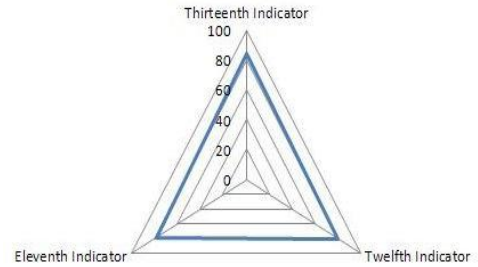


Figure 9. Financial capability

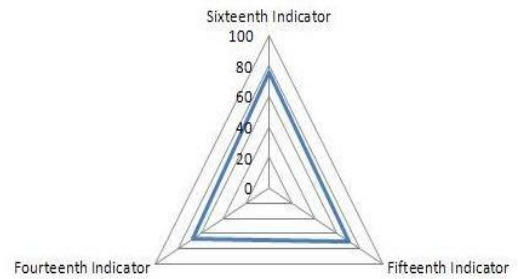


Figure 10. Organizational structure capability

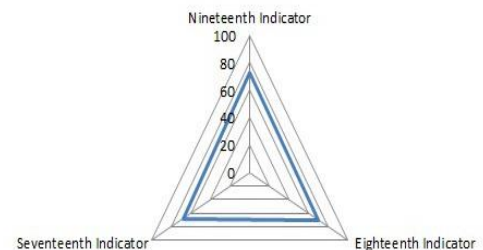


Figure 11. Intellectual capital capability

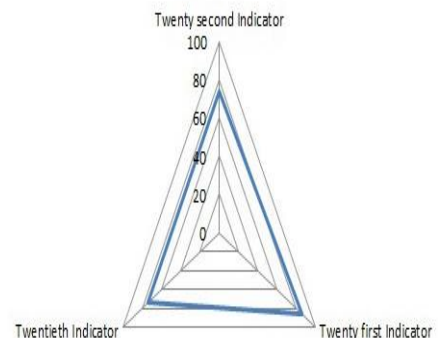


Figure 12. New product development process capability

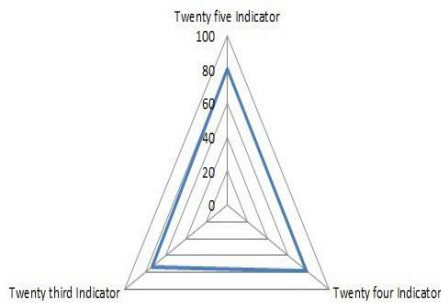


Figure 13. Management capability

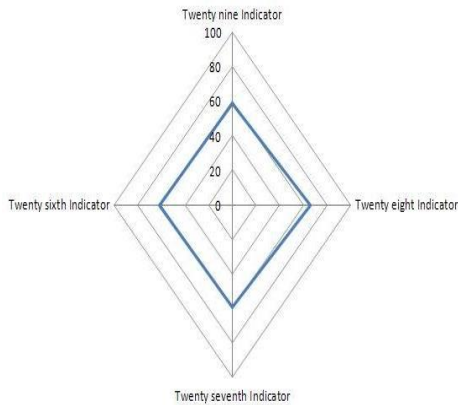


Figure 14. Strategy capability

Discussion on Results and Recommendations

Thus, considering results obtained in the current research, following recommendations are made for improving and strengthening two weaker dimensions, i.e. strategy and customer and market dimensions.

Recommendations for strategy dimension improvement:

(1) In research and development organization it is recommended that total and partial goals are specified prior to development of a new product. In fact, approximate size of the sales and profits of the product should be determined from the beginning, and research and development plans should be closely related to overall plans and strategies of the organization based on the sale volume and profit size.

(2) It is also suggested that research and development organization simultaneously uses various strategies such as product platform, derivatives of product platforms, totally new product, products with partial changes, etc. so that the organization would be able to optimally use its total power in different areas. Also, different classes of costumers should be taken into account. In this case, the organization will grow in most technical and non-technical fields and it will lead to good development and changes in short and long term.

(3) For improvement of strategy capability, appropriateness between business goals and new product development goals is necessary, and role of new products in achieving these goals should be specified, so that if the appropriateness is low, the product is not chosen as new product and resources are not wasted.

(4) Additionally, it order to having better future for the organization it is proposed that new products are considered with the purpose of international markets and they are not merely confined to the domestic markets. Considering current status of Iran and probable new communications with industrial states, it is necessary to construct product development structures based on industrial states and products are developed with better standards.

Recommendations for customer and market dimension improvement:

(1) Prior to new product development, a website can be designed for receiving customer information and customer information should be received via it before new product development and production, and the most practical propositions can be applied in designing the products. Financial and non-financial incentives can be considered for improving this item and receiving better ideas from the customers so that they are motivated. Additionally latest technical ideas and activities of the competitors can be informed by having technical observers. In this way, repetition of ideas in new products is prevented through being aware of their ideas.

(2) Often after new product development and production, research and development organizations become aware of the product performance through customer compliant units. It is suggested that representatives of research and development organizations are informed of the new products' performance and quality for increasing productivity and overcoming existing defects better and quicker.

(3) It is suggested that prior to new product development process beginning, market power and market share and market size are measured. Thus, better and more effective planning can be done for products in terms of quality and quantity.

Regarding stronger dimensions of the organization including financial and technology capabilities as well as average dimensions including intellectual capital capability, organizational structure capability, research and design capability, management capability and new product development process capability, it is suggested that stronger resources and capabilities of research and development organization are used for covering defects in weaker ones using SWOT matrix. For example, financial and technology capabilities can be used for overcoming strategy defects, and outside consultants and academics can be utilized and better strategies can be formulated for the organization. Using technology capability it is possible to design and implement web based sites for customer relationship parts in research and development organization. Intellectual capital and management capabilities can be used for solving strategic problems of the organization. Also, recommendations made for customer related website design and strategy and market and customer capabilities can be used.

Comparing Findings with Reviewed Literature

Table 8 gives comparison of prioritization of dimensions considering conceptual model and evaluation in current research.

Considering Table 8 it is clear that in the basic conceptual model, research and design, financial, and technology capabilities are respectively in highest importance and according to the evaluation in Iran Khodro Co., following capabilities are more powerful: financial and technology capabilities, and it is optimal. However, research and design capability was in the fifth rank. In this regard, it is better that organization takes necessary measures for capability in this dimension. For example, it can have constant innovation on ideas of new product development from the beginning until maturity stage, and promote its basic and applied research capacity.

(1) New product development process and management capabilities were in the third and fourth ranks in the evaluation in this research, which are in better ranks compared to the basic conceptual model.

(2) Results of evaluation in this research on intellectual capital, and customer and market capabilities indicate that they are in seventh and eighth ranks and it is not optimal compared to the conceptual mode. Thus, it is suggested that research and development organization in this company uses such measures as application of expert staffs' implicit and explicit knowledge and financial and HR experts and other experts as matrix for improving intellectual capital capability. Recommendations above can be used for improving customer and market dimensions.

Table 8. Comparing Prioritization of Dimensions Considering Conceptual Model and Evaluation in Current Research

No.	Priority of Dimensions Considering Conceptual Research Model	Priority of Dimensions Considering Evaluation in Current Research
1	Research and design Capability	Financial Capability
2	Financial Capability	Technological capability
3	Technological capability	New product development process Capability
4	Customer and market Capability	Managerial Capability
5	Intellectual capital Capability	Research and design Capability
6	Organizational structure Capability	Organizational structure capability
7	New product development process Capability	Research and design Capability
8	Managerial Capability	Customer and market Capability
9	Strategy Capability	Strategy Capability

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